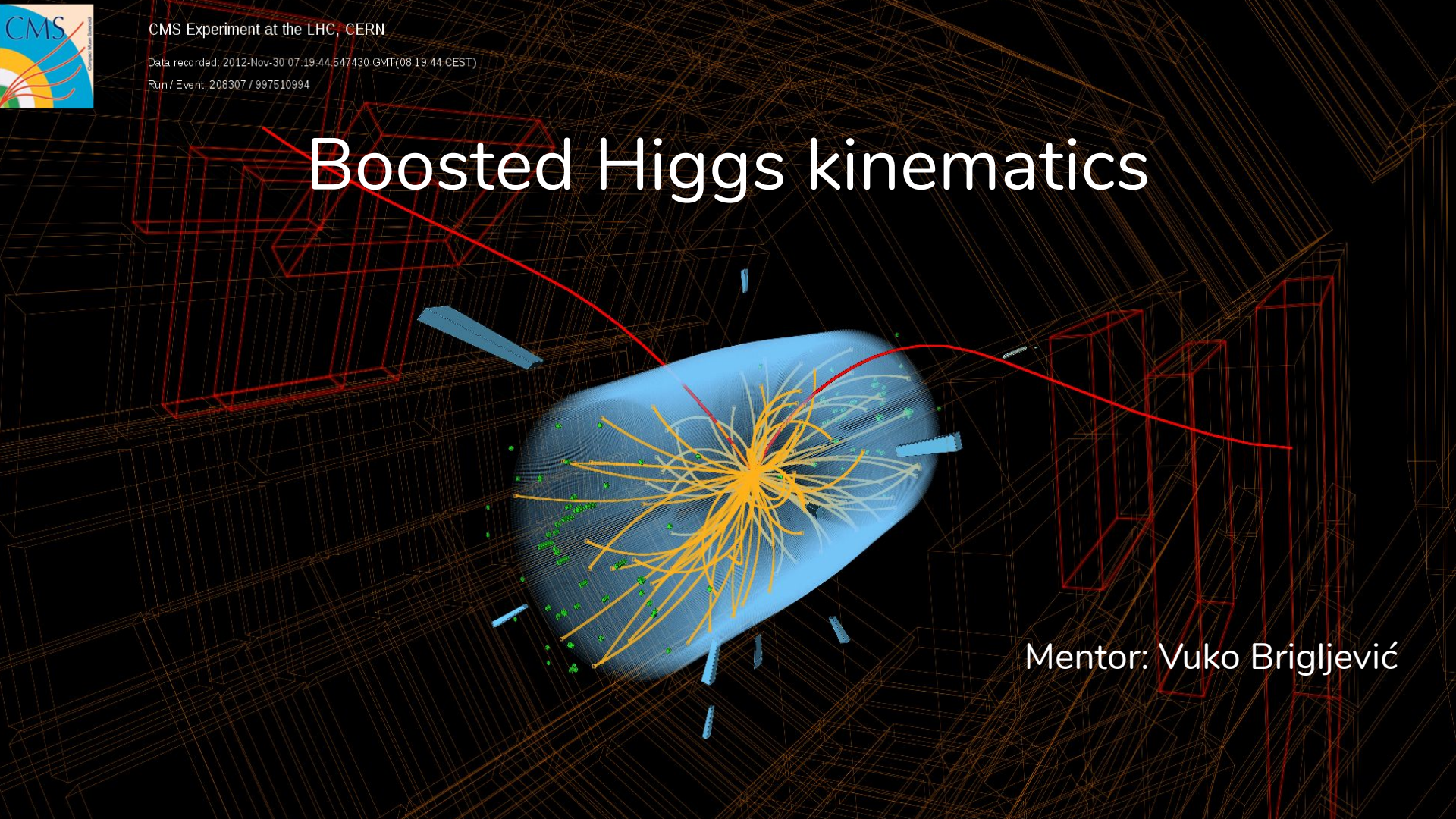
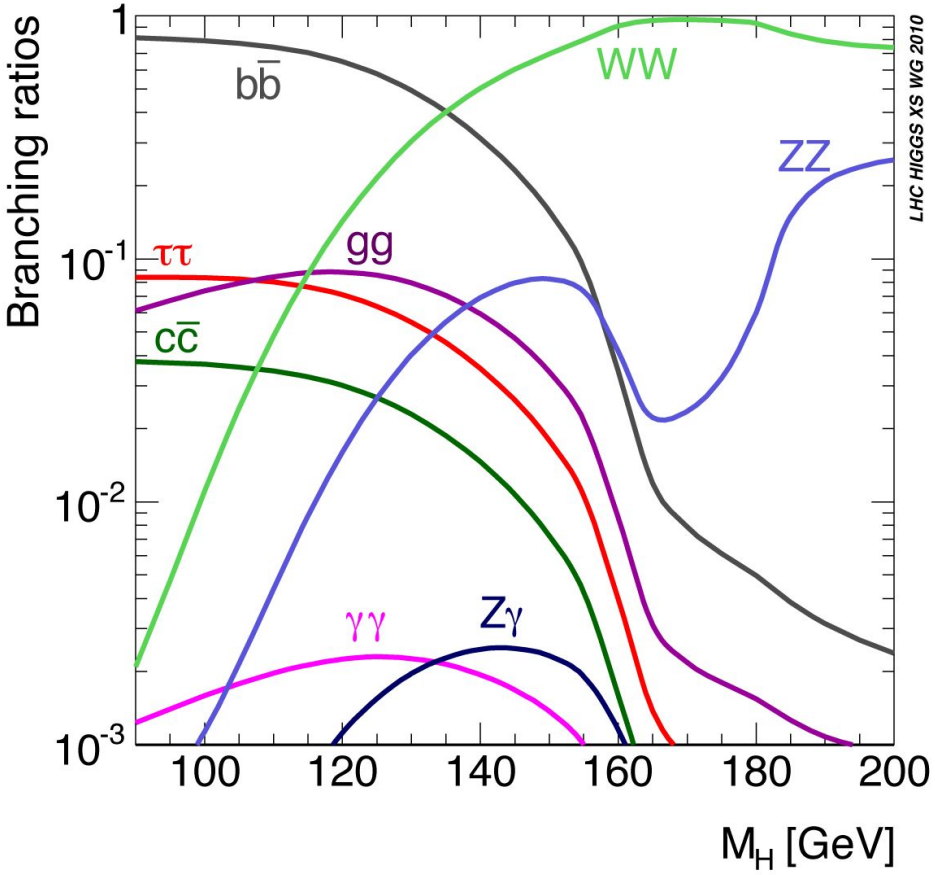


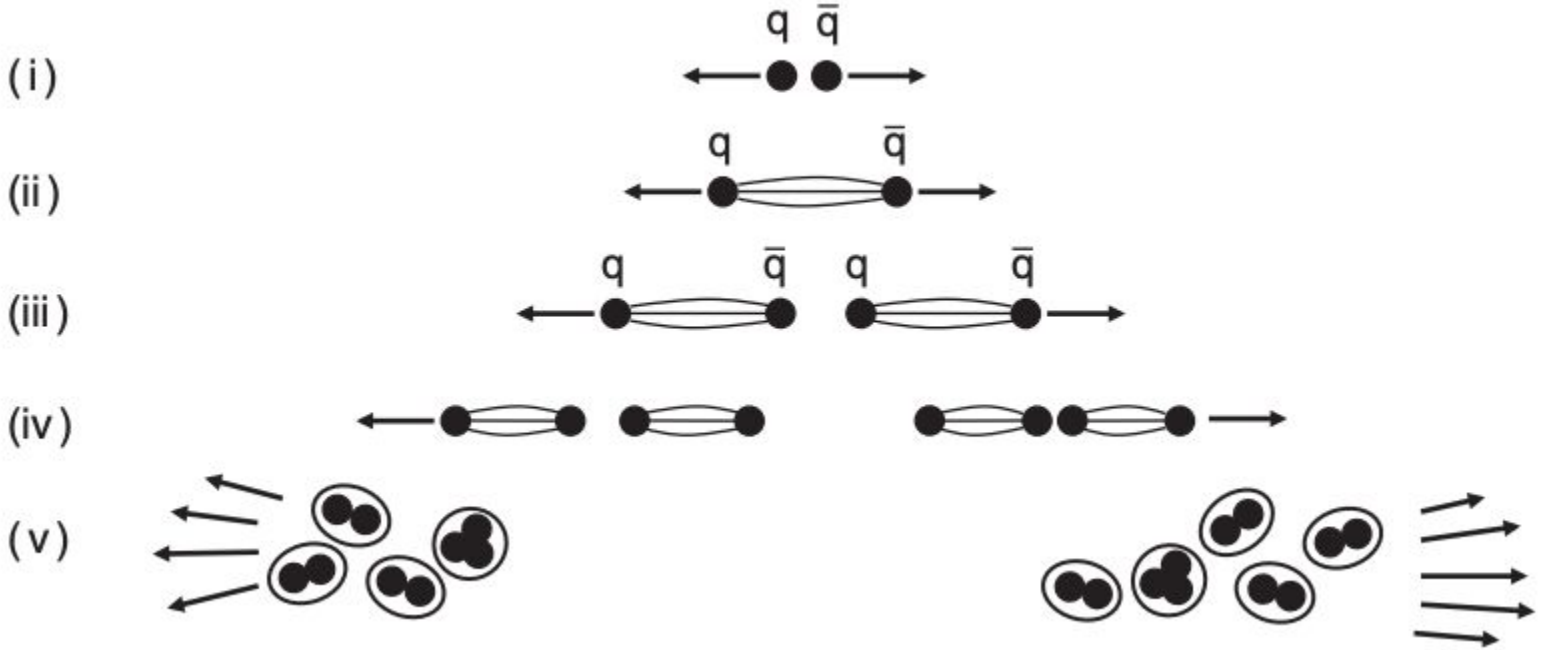
Boosted Higgs kinematics

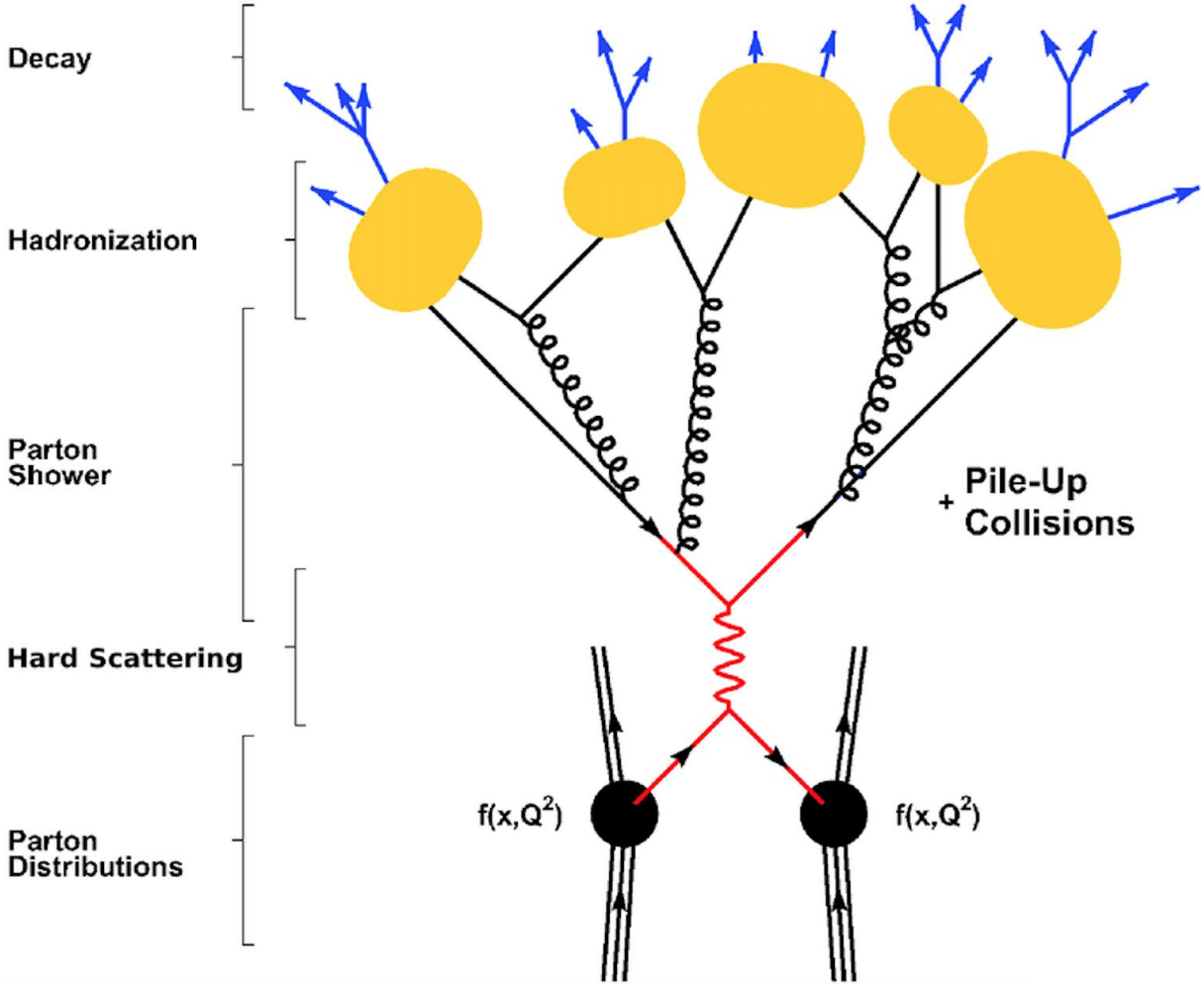
Mentor: Vuko Brigljević

- Higgs decay branches
- Initial Higgs detections
- b quark decay detection?



Schematic of hadronization process




Decay
Hadronization
Parton Shower
Hard Scattering
Parton Distributions
+ Pile-Up Collisions
f(x,Q²)
f(x,Q²)

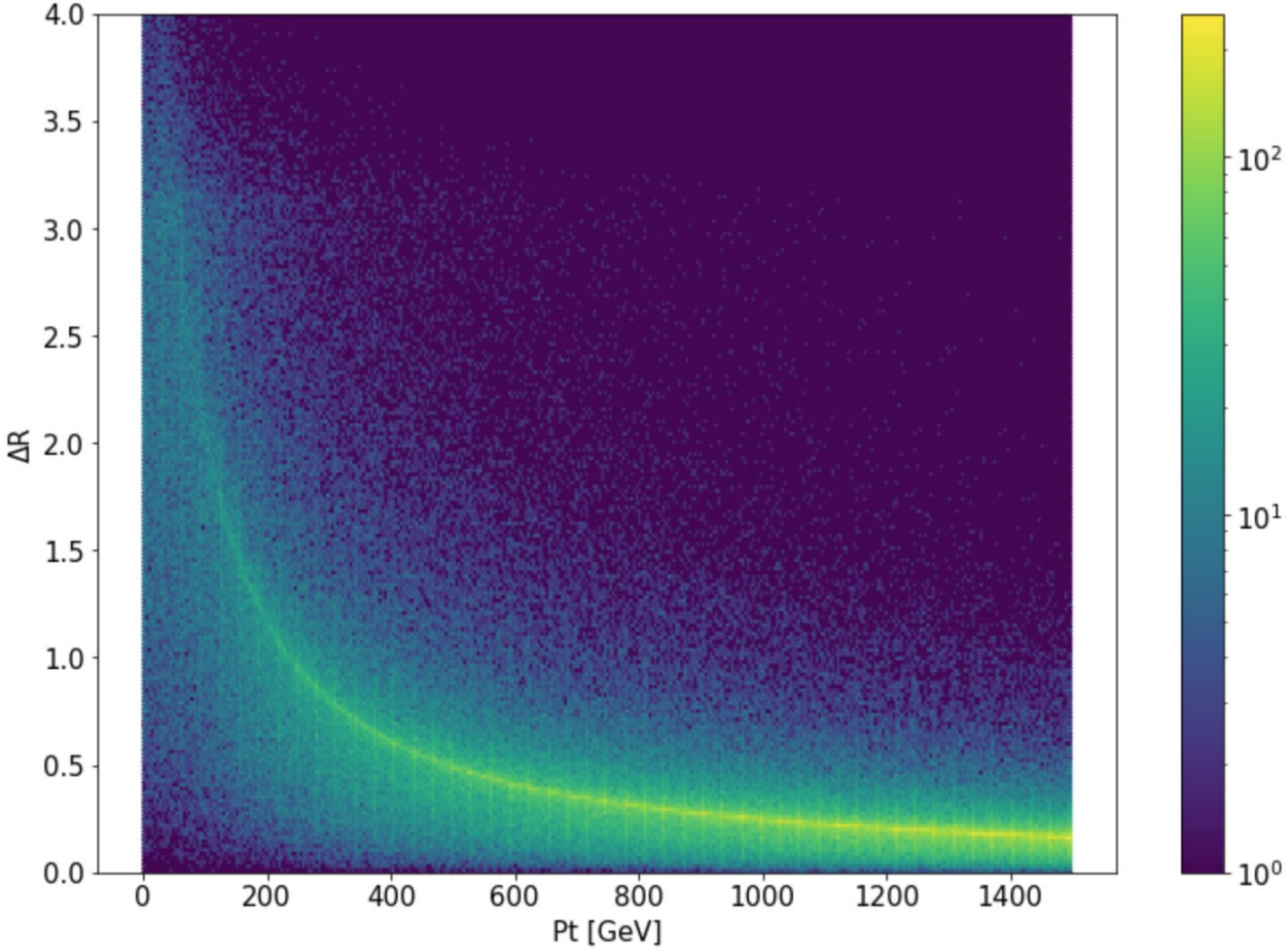
Boosted regime

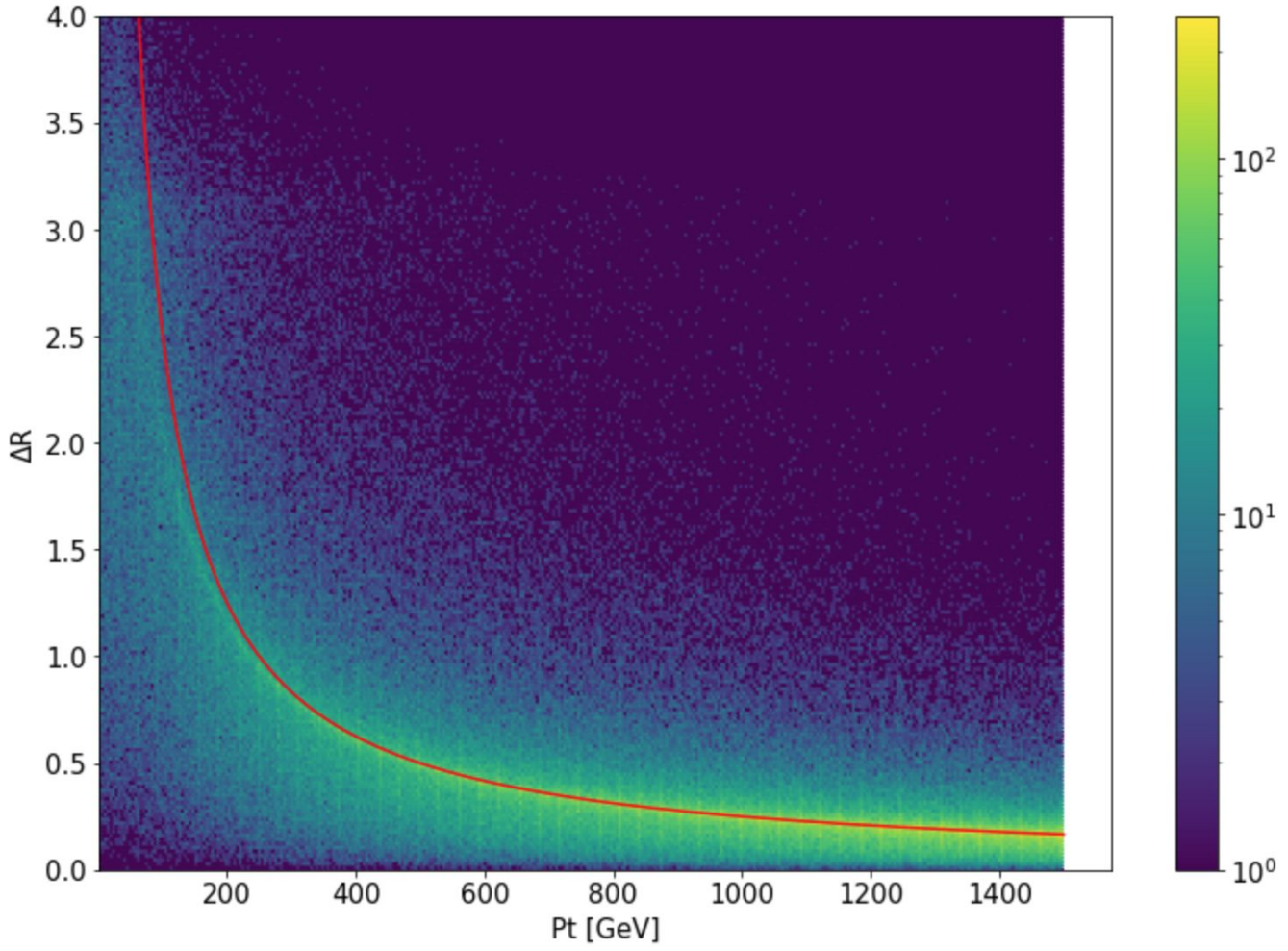
- Kinematic variables

1. Transverse momentum: $p_T = \sqrt{p_x^2 + p_y^2}$
2. Pseudorapidity: $\eta = -ln\left[\tan\left(\frac{\theta}{2}\right)\right]$
3. Angular distance: $\Delta R = \sqrt{\Delta\eta^2 + \Delta\phi^2}$

Python symulations

- In CM frame the decay is isotropic
- Generating random angles in CM frame
- Lorentz transformation to the laboratory frame
- Calculating ΔR dependence on transversal momentum
- The most probable ΔR distance is given by: $\Delta R = \frac{2m_H}{p_T}$

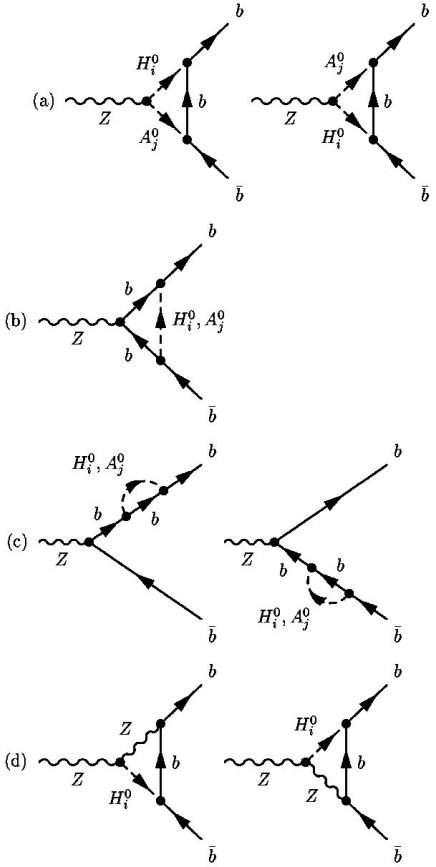

4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ΔR
0
200
400
600
800
1000
1200
1400
Pt [GeV]
10^2
10^1
10^0

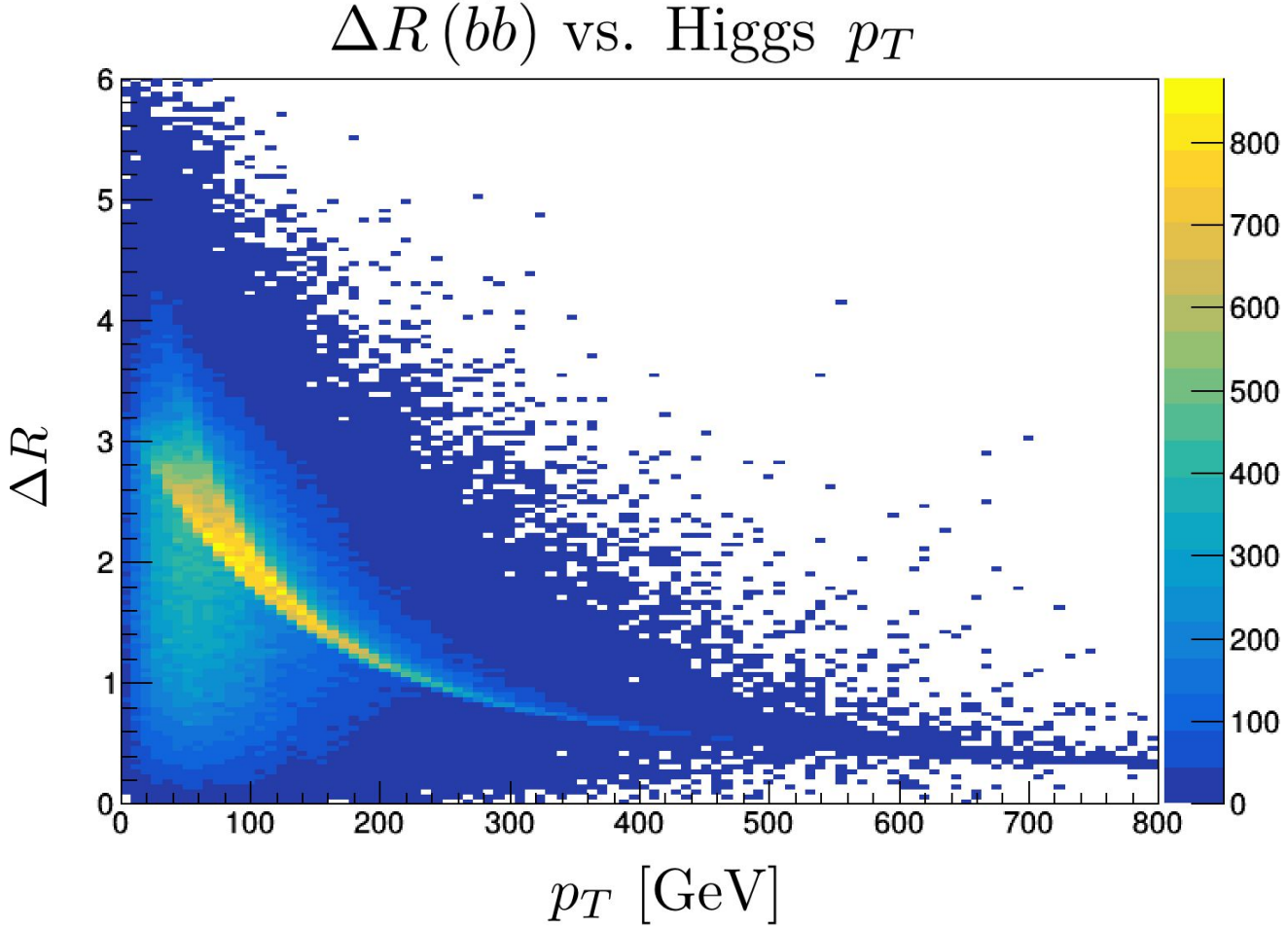

4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ΔR
200
400
600
800
1000
1200
1400
Pt [GeV]
10^2
10^1
10^0

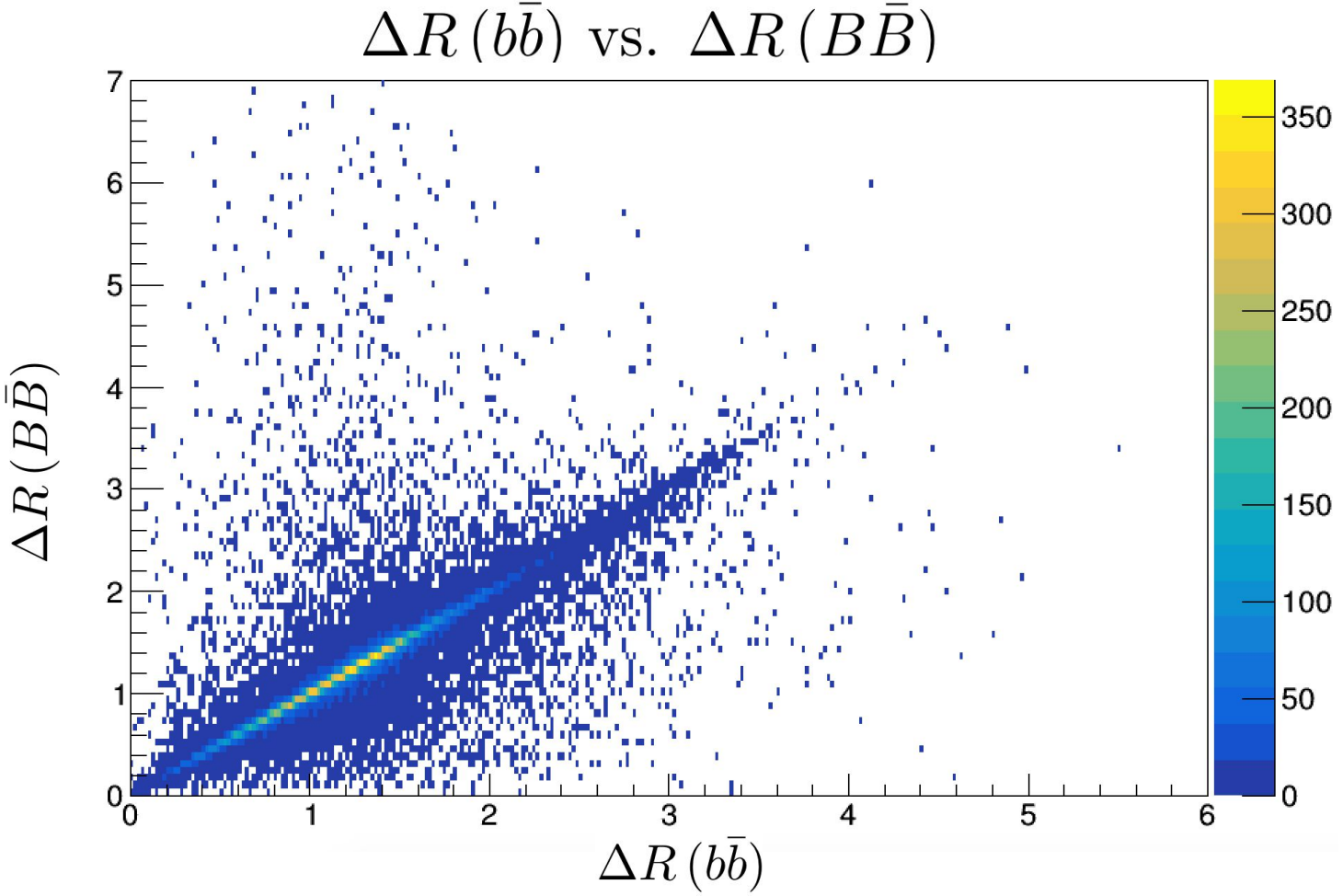
Simulated data

- Simulations of proton-proton collision are generated in three steps

1) Monte-Carlo simulation
2) Detector response simulation
3) Reconstruction

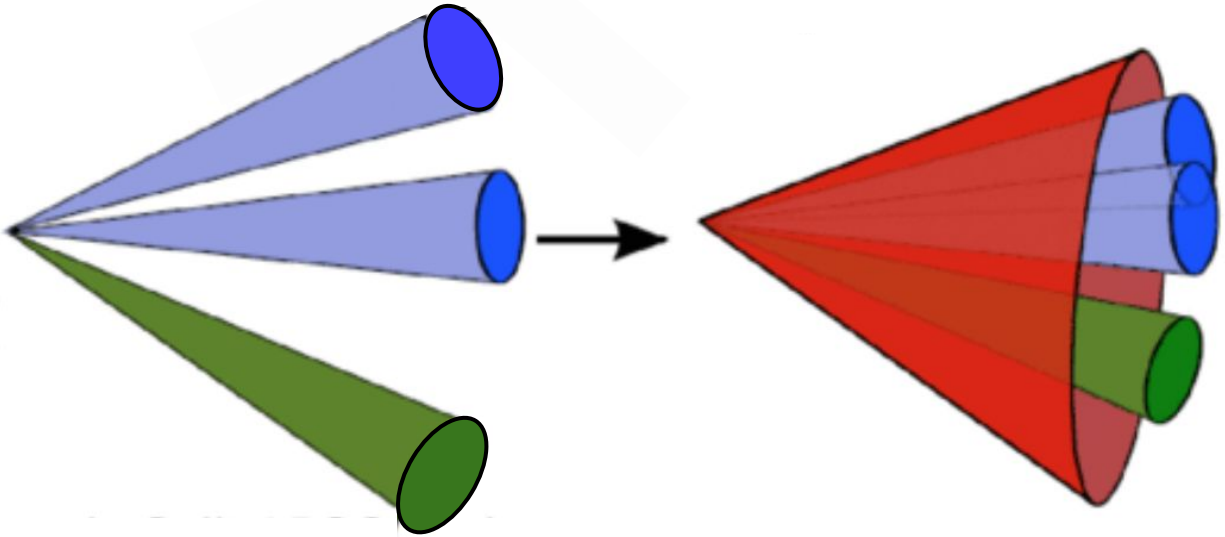



$\Delta R\,(b\bar{b})$ vs. Higgs p_T
ΔR
p_T [GeV]
0
1
2
3
4
5
6
0
100
200
300
400
500
600
700
800
0
100
200
300
400
500
600
700
800


$\Delta R\,(b\bar{b})$ vs. $\Delta R\,(B\bar{B})$
$\Delta R\,(B\bar{B})$
$\Delta R\,(b\bar{b})$
0
1
2
3
4
5
6
7
0
50
100
150
200
250
300
350

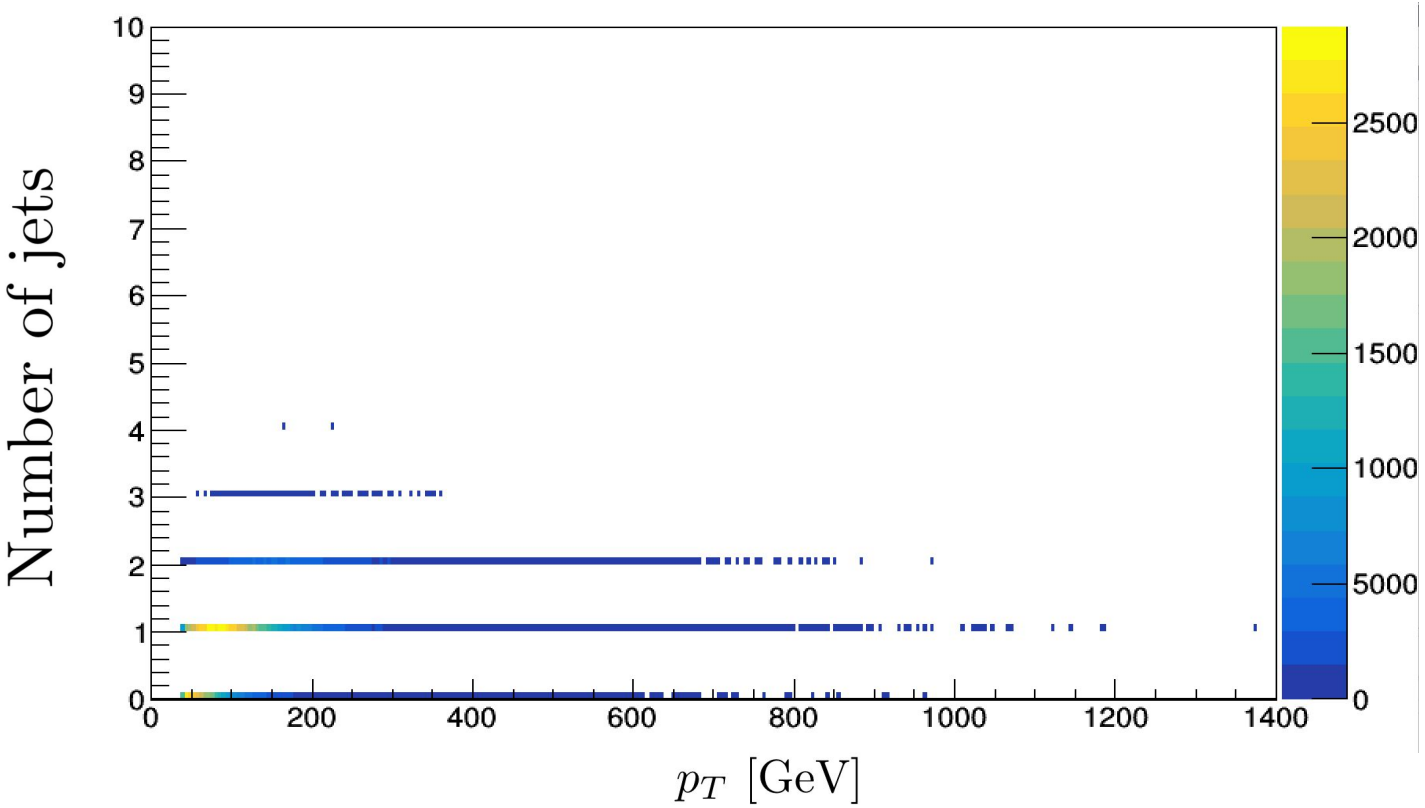
Jet clustering

- Narrow jets
- Fat jets

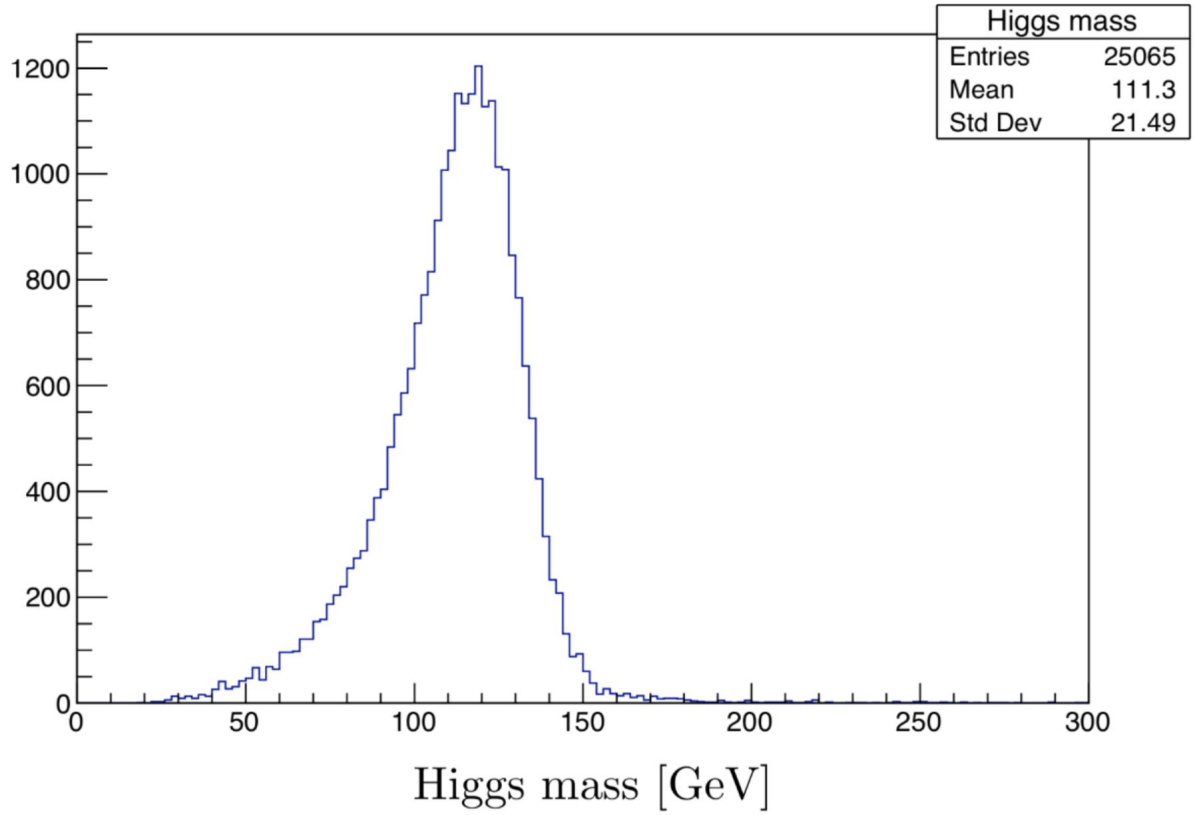


Number of narrow jets against Higgs pt

$\Delta R < 1$



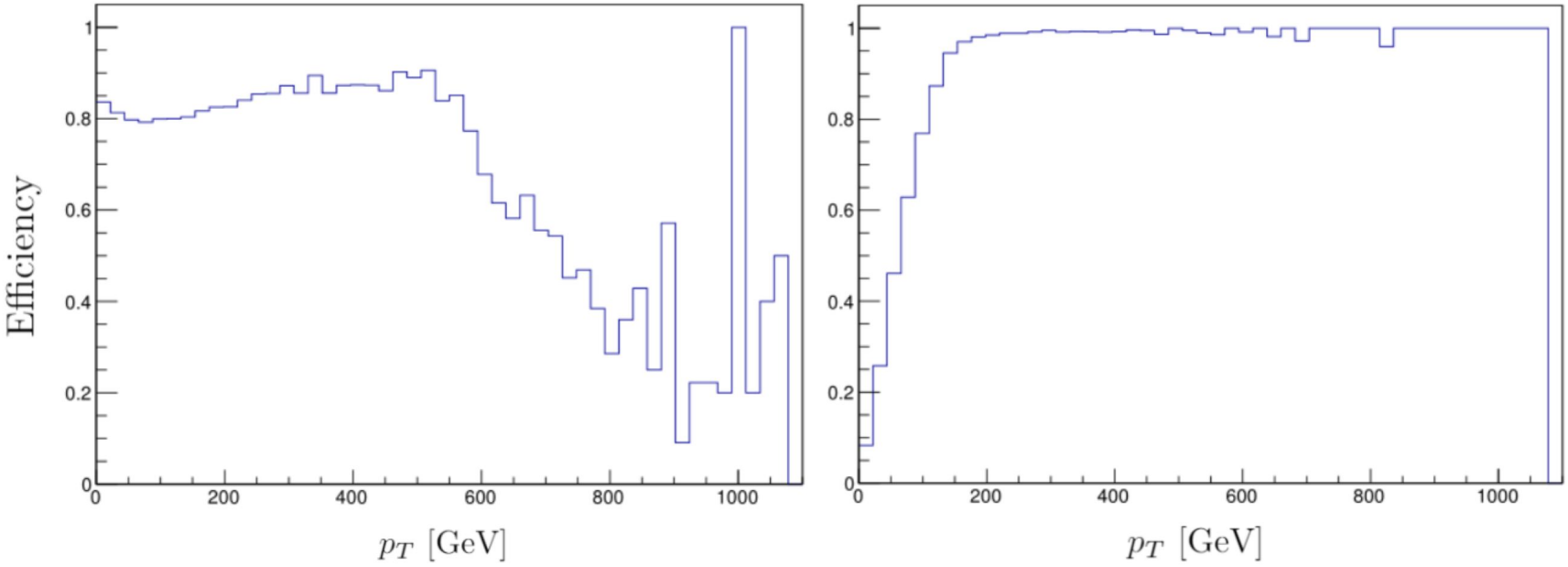
Higgs mass spectrum using narrow reco jets



Jet efficiency

- Which type of jet to use to successfully reconstruct Higgs?
- Definition of efficiency
- Efficiency dependence on Higgs transverse momentum

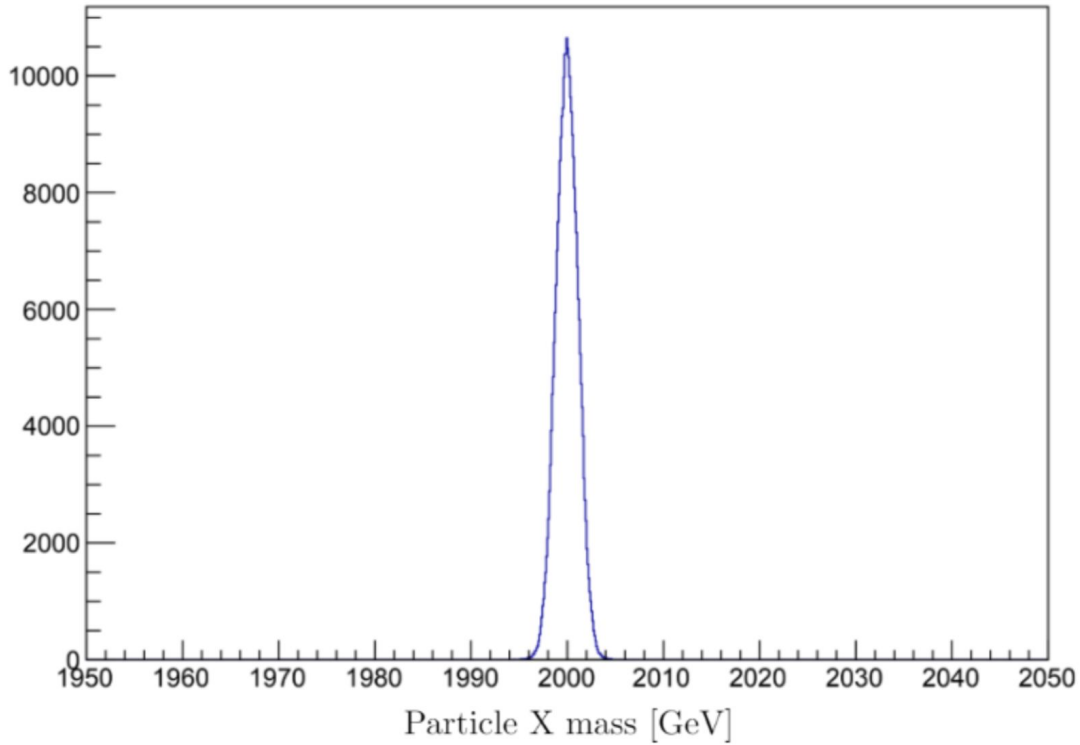
Jet efficiency against Higgs pt (narrow and fat jet)



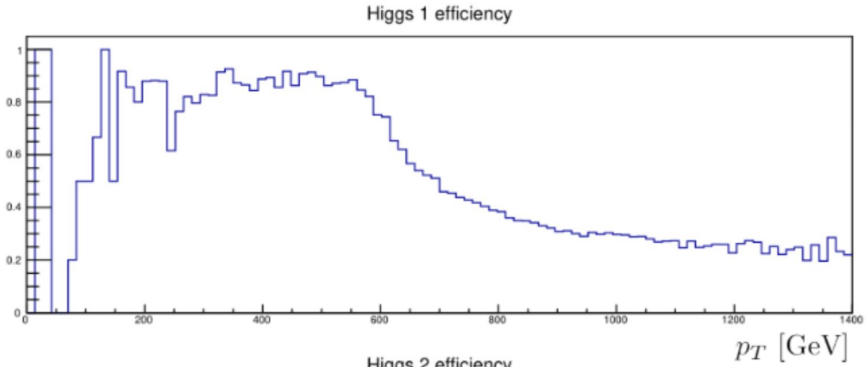
Di-Higgs decay analysis

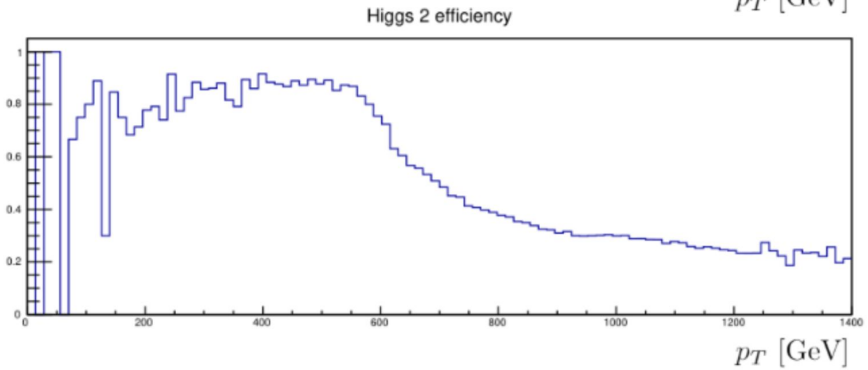
- Analysis of particle X decay into 2 Higgs bosons
- Large mass implies necessity of boosted regime for product analysis
- Analysis of jets efficiencies
- Difference between generated (AK4/AK8) and reco jets
- Possible improvements to the mass resolution

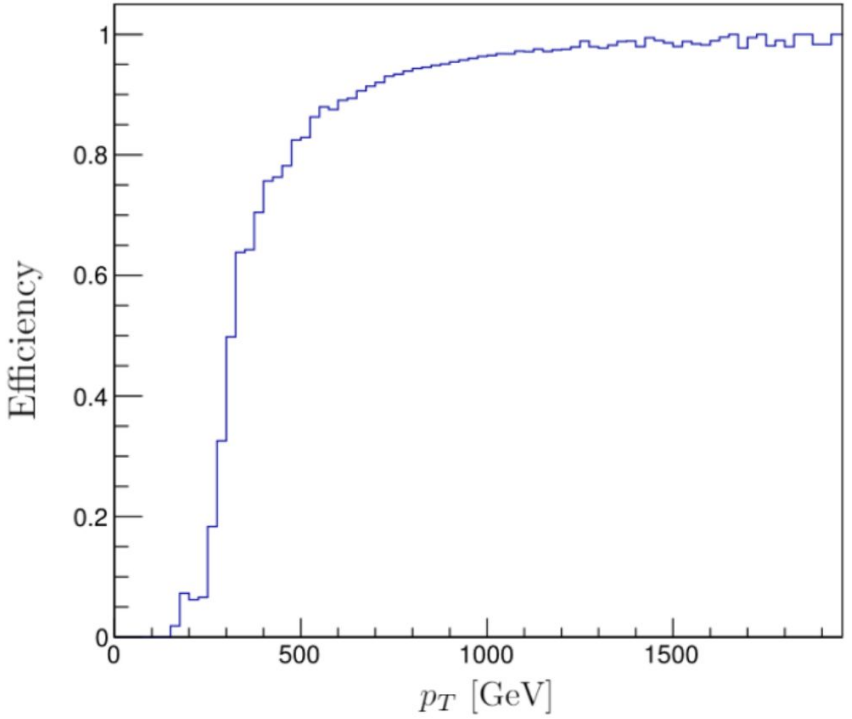
Particle X mass spectrum



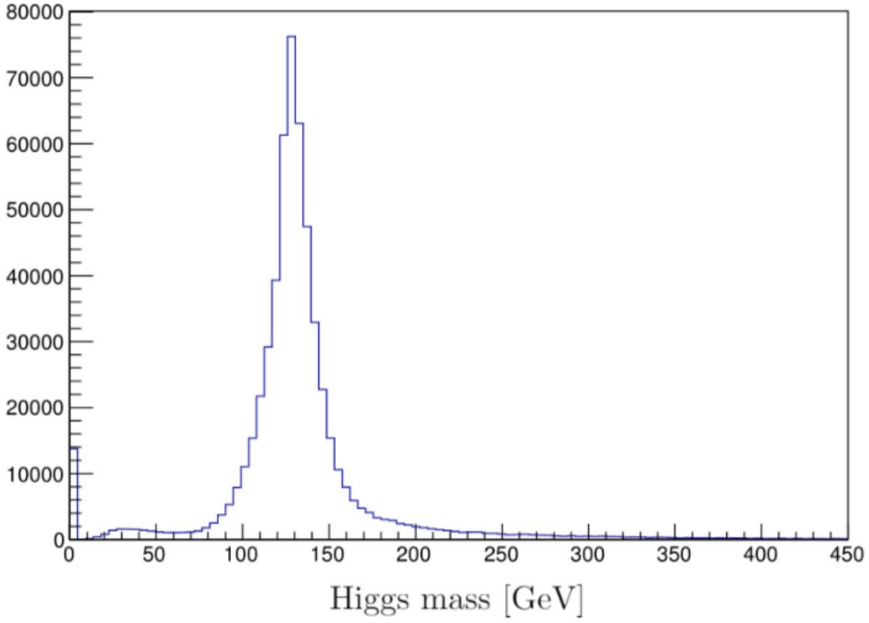
Narrow and fat jet efficiencies (di-Higgs sample)

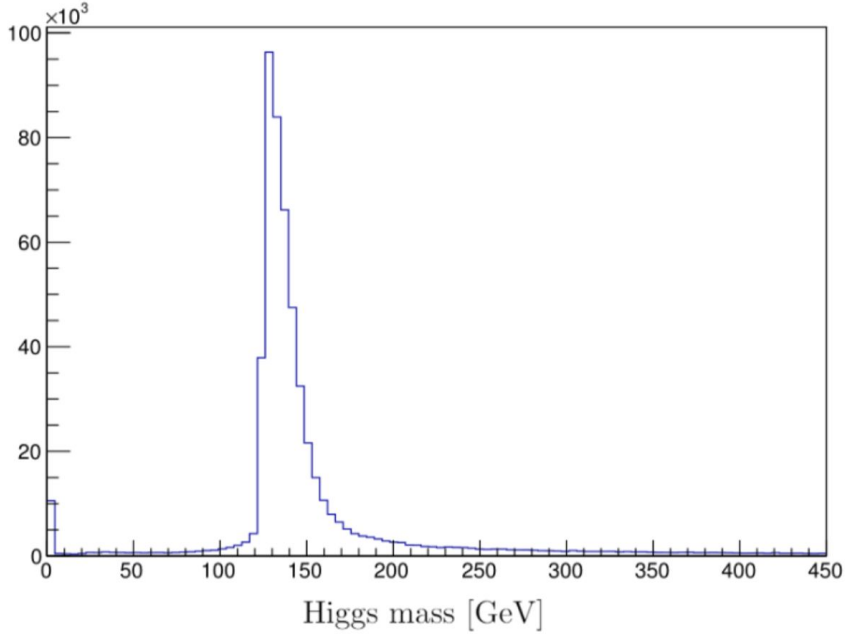






Higgs resolution (AK8 jets vs. AK8 jets + neutrinos)





Thank you for your attention!